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ABSTRACT

Conclusions of a conference which focused on the educational and research needs for computer-related instruction in the European secondary schools are outlined. Conference members, who were representatives of Ministers of Education, generally concluded that it is vital to offer some computer studies for all students in secondary education. Too much specialization, however, should be avoided. All teachers should learn how to use computers in the classroom. In terms of content, students should learn the implications and limitations of computers; how to store, retrieve, and structure information; and the impact of computers on society and career prospects. Caution is advised when implementing computer studies in schools; the imposition may lead to failure. Currently, skepticism exists toward computer assisted instruction (CAI) because of bad experiences with programmed learning in the 1970's. It is now apparent that teachers must adapt technology to education, not education to technology. Although CAI still demands considerable financial resources, advantages include promoting the intellectual development of ordinary and handicapped students, modernizing the curriculum with simulation games, and assisting teachers in tasks. CAI should be flexible and favor an interdisciplinary approach. Finally, research should consider children's needs, be developed in cooperation with classroom teachers, and concentrate on the didactical use of computers in different disciplines. (KC)

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THE NEW TECHNOLOGIES AND EDUCATION IN EUROPE (CCC AREA)

by

Michael Vorbeck

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Paper presented at the Annual Conference of the Social Science Education Consortium, Inc., (20th, Athens, GA, June 8-11, 1983).

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THE NEW TECHNOLOGIES AND EDUCATION IN EUROPE (CCC AREA)

INFORMATION NOTE

prepared by

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The Directorate of Education, Culture and Sport, Documentation Section

1. BACKGROUND

The new (information) technologies, in particular computers, are playing a more and more important role in the member states of the Council of Europe's Council for Cultural Co-operation (CCC) *. Society and the labour market are influenced by computers.

So far, general education in most countries tended to neglect problems of technology, leaving them to vocational education. Co-operation between general schools and the world of work was not well developed. In view of the rapidly increasing computerisation of life on the one hand and growing youth unemployment on the other, politicians, industry and trade unions urged schools to improve the preparation of young people for life (see the CCC's Project "Preparation for Life") and to make them familiar with new technologies.

2. COUNCIL OF EUROPE ACTION

Ministries of Education, concerned about the issue, took the problem up at European level and had it included in the CCC's programme for 1982. At the invitation of the Italian Ministry of Education, an Educational Research Workshop was held at Frascati (near Rome) in November 1982. Its aims were:

- To evaluate research in the field of computer-related instruction at secondary school level.
- To draw attention to the consequences of research findings for educational policy.
- To identify areas of future research.
- To encourage European co-operation in this type of research.

Commissioned papers and national reports, both describing the present situation as well as research and experience, were discussed in plenary and group sessions. The conclusions were summed up by the Rapporteur General (Mr. William R. BRODERICK, UK). All the papers will be published by Swets Publishing Company (Heereweg 347b, NL-2160 AH Lisse) in autumn 1983.

A similar Workshop is to be held in Scotland in 1984 and will discuss science and technology (including computer studies) at primary education level.

3. THE GENERAL PICTURE
(emerging from the Frascati Workshop)

3.1 Present situation in CCC countries

- There is growing concern among educational authorities about introducing some form of computer studies at school.
- Apart from training programmes for future computer specialists (offered in all countries), vocational education programmes for non-specialists at upper secondary level have been developed in numerous countries. The aim is to prepare young people for contact with the world of computers within their chosen occupational fields.

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* Austria, Belgium, Cyprus, Denmark, Finland, France, Federal Republic of Germany, Greece, Holy See, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom of Great Britain and Northern Ireland.

- In general secondary education, some countries have made serious attempts to introduce computer studies, computer science and computer-based learning and to provide all schools with computers. The most advanced countries in this respect are perhaps France, the Federal Republic of Germany, Sweden and the United Kingdom. In France, Bavaria (Federal Republic of Germany), England and Scotland, nationwide programmes have commenced (e.g. micro-electronics programme in England and Scotland).

  Where there are no such national programmes, all the many initiatives and pilot experiments are often not well co-ordinated within the framework of an interaction network.

- Certain countries (e.g. Austria and Switzerland) are somewhat reserved as regards the nationwide introduction of computer-related instruction in general education and prefer to concentrate their efforts on vocational education. Some people argue as follows: People cope with motorised society without studying automobile science at school, why should this be different in the case of computers ! Others, however, point out that computerisation has resulted in greater intellectual mobility, and this, contrary to physical mobility, requires preparation at (general) school.

- Opinions are divided as to whether computer education should be commenced at pre-school and primary school levels. Some people argue that children should at least learn how to use a computer as a tool (not at this stage for problem-solving but for simple things such as counting, adding and subtraction). The UK offers a good example of this approach.

3.2 Main conclusions from the Frascati Workshop
(for details see Chapter 4)

3.2.1 Schools not yet engaged in computer-related instruction should be encouraged to take a big step forward.

3.2.2 It is vital to offer some computer studies for all children in secondary education (either in the form of a separate subject or through the various other disciplines) to achieve "computer literacy" (but one should not offer too much). Programmes in Austria, France, the Federal Republic of Germany and the UK might serve as an example.

3.2.3 Computers are becoming cheaper and cheaper so that nearly all schools can afford one, but it is not enough just to count the number of schools so equipped. Quality matters more than quantity. Many of the computers used in schools are technically out of date and far too difficult to handle.

3.2.4 Computer science should be offered to pupils interested in learning more about computers (in general as well as in vocational education), because in 15 years 50% of all jobs will be affected by computers. Too much specialisation should, however, be avoided, otherwise graduates will not be employable. Research confirms that the French, German and British approaches to computer science as an option has been quite successful.

3.2.5 Experience shows that computers can be a very useful learning tool in all disciplines. There is no need to fear that computers will ever replace the teacher.

3.2.6 The range of suitable software offered at school is still far too small. What has been developed elsewhere might be taken over and adapted to local conditions.

3.2.7 All teachers should learn something about computers in their initial education. In-service education and training is even more vital, because the relationship between teacher students and teachers in service is 10:90. All teachers should learn how to use computers as a tool in the classroom.

3.2.8 One should, however, not be too optimistic about computer-related instruction in secondary education. The bad experience with programmed learning in the 1970s, as well as earlier illusions about the rapid spread of audiovisual aids in the classroom, would seem to justify a word of caution. Even if microcomputers have become cheap, computer-related instruction will require considerable investment (e.g. software packages) and teacher training efforts.

3.2.9 Future research should examine the optimal degree of specialisation to be offered in computer studies.

3.2.10 Future action should concentrate on making good examples (case studies, software packages for various subjects, etc.) more widely known.

4. COMPUTER-RELATED INSTRUCTION IN EUROPEAN SECONDARY EDUCATION

(Detailed conclusions from the Frascati Workshop based on the General Rapporteur's summary and group reports)

4.1 Computer studies for all pupils

Some introduction to computers is essential, both in general and vocational education. Many would even speak of computer literacy but not all countries accept this notion. Experience shows, however, that school should offer enough but not too much.

4.1.1 Contents of computer studies for all

- Pupils should know of the implications and limitations of computers, which will figure more and more prominently in life.

- They should learn how to store information, how to retrieve it and how to structure it in order to deal with problem-solving.

- They should know how to explore a number of applications of micro-electronics in business and industry.

- As a consequence pupils should have some idea of the impact of computers on society and career prospects and be able to cope with social problems that may arise.

- Programming should occasionally be taught but is not really necessary for all pupils (maybe for just 20%). What matters is that all learn to understand the basic elements of a computer programme. A particular computer language learnt in school may be useless in later life.

- Positive experience has been gained with ready-made packages to illustrate computer use.

- Teaching the technology of particular machines is useless.

4.1.2 Strategies for the introduction of computer studies

- Computer studies often fail to be successful because teachers have not be involved in the preparation and development of the teaching programmes.

- The imposition of computer studies may also lead to failure.

- Schools should not duplicate their efforts but look to models elsewhere and adapt these to their own needs.

- Practice should be related to the needs and abilities of pupils.

- Two approaches have, so far, supplemented each other: (1) schools offering proper computer courses (e.g. the 24 hour minimum programme used in Switzerland) and (2) schools promoting the didactical application of the computer in various subjects (see item 4.3 below).

- Computer studies as a compulsory subject (with a fixed number of hours per week over a period of several years) at primary or lower secondary level cannot be enforced under present circumstances.

- As it may take up too much time for teachers to familiarise themselves with computers, a compulsory course (rather than treating it as a subject in its own right) might be the easiest solution.

4.1.3 No reason for optimism

- One has to be realistic in the face of all these suggestions. Ministries of Education and the general public sometimes overestimate the value of computer studies. In most countries conditions are such that spectacular results cannot be achieved overnight. A ministerial decree ordering computer studies for all as from, for example, next Monday, would not be acceptable in most countries.

- Ministries will have to examine how they can best influence classroom practice to ensure that appropriate action is taken.

4.2 Computer science for some pupils

4.2.1 Need for more in-depth studies

- In about fifteen years 50% of all jobs in Europe will be influenced by computerisation. It is obvious that many people will need to have a little more knowledge about computers than is suggested in 4.1.

- Computer-based education should not be left to industry to train on the job as this would probably be too specialised and neglect to impart an all-round approach to computers.

- Computer studies for the 11-12 age group would facilitate the comprehension of algebra.

4.2.2 Place of computer science

More countries are now offering "computer science" as an optional subject at least at the upper secondary level (general and/or vocational). Where

it is an option parallel to others (e.g. in the UK) pupils tend to choose it in preference to art, cookery, geography, etc. In other cases, positive efforts have been made to integrate computer science with other subjects (e.g. mathematics) provided the teachers were willing and properly trained. However, it has not been possible anywhere to make computer science a subject in its own right and compulsory for all.

4.2.3 Aim of computer science

The aim is not to train computer specialists but to go beyond the general introduction (computer studies, see 4.1 above) and to deepen the basic knowledge of those pupils who are particularly interested in computers.

4.2.4 Contents of computer science

- Here, too, one has to avoid too much specialisation as otherwise young people who have already studied computer science at school will not be flexible enough for the labour market.

- No uniform contents should be imposed for all, however, much will depend on local circumstances. (Programmes offered in the UK are a good example.)

- What matters is real life practice and not just theory, for instance, logic and arithmetic, architecture, system software, system design, approaches to programming (retrieval), comparative study of computer languages (there is controversy as to whether it is of any use at all to study a particular computer language), information and control technology and perhaps information theory, telecommunications, automation, electronics, simulations, principles of computer operations, practical applications and their influence on society.

4.2.5 Requirements of computer science

- Experience shows that it is necessary to prepare a proper but flexible syllabus and material which can be adapted to local needs. Teachers will need a constant supply of material describing relevant activities and developments.

- Teachers in charge of computer science require adequate academic and professional training (see 4.5 below) and should know about the possible uses of computers. Practical experience with computers would be helpful.

- Pupils often tend to be over-enthusiastic about computer science. They need a certain basic knowledge (general introduction) about computers before deciding whether or not to opt for computer science, otherwise they may be disillusioned. (The UK has experienced an explosion of pupil interest in computer science as an optional subject: 7,000 in 1974; 54,000 in 1981.)

4.3 Computer-assisted learning (CAL)

4.3.1 Experience in Europe

- Computers have changed the world of work and the opinion held by the public as regards many subjects taught at school. As a result syllabuses will have to be changed.

- Bad experiences with programmed learning in the 1970s has led to a lot of scepticism as regards CAL.

- It is possible to use computers in all subjects (computers can even compose music) provided the teachers are properly trained. There is research on the best didactical use of computers and quality software (with good documentation) is being developed.

- The concept of CAL has changed over the last fifteen years. The teacher is now seen as an integral part of it and the cost of equipment has been reduced.

- There are two types of useful material: that for demonstration purposes and that for interactive use by the pupil.

- Teachers must adapt technology to education, not education to technology. Schools might ask industry to produce adequate material but it would not be good to have computers produced for exclusive use in schools.

- CAL still demands considerable financial resources and political will on the part of the authorities. To produce good material is difficult and expensive. Zero growth rates in Europe may, therefore, pose an obstacle to CAL.

- Experience with computers in the different subjects has to be realistic otherwise interest is lost.

- CAL fails if imposed.

- Teachers must be involved in the development and design of CAL.

- Pupils, teachers or designers may be in control of the activity (there are good examples of all three approaches in Europe) but it is important to know why that person is in control.

4.3.2 Advantages of CAL

- Good or bad use can be made of CAL. If the right use is made of it it can be a very useful learning and teaching aid.

- Work with computers helps to promote intellectual development of (ordinary as well as handicapped) children. The computer forces pupils to structure problem-solving efforts and imposes clear definitions.

- Simulation games by computer (e.g. ecologic or genetic processes in biology, elections in civics, construction of data bases in history) are quicker, cheaper, safer and often socially more easily acceptable than traditional experiments.

- Simulation games help to modernise curricula and to make them more relevant.

- Information retrieval via the computer is a good learning tool because it requires logical thinking.

- Computers assist the teachers in their tasks: text processing, data bank, etc.

- CAL facilitates interdisciplinarity.

- CAL may also help with remedial work.

- Computer-based learning environments facilitate access to mathematics.

4.3.2 The teacher's role in CAL

- Already television has changed the role of the teacher in the classroom and in society. CAL will alter it even more in the sense that teachers will no longer be the first source of information.

- There is no need to worry. CAL will not replace teachers. On the contrary, CAL will support them.

- CAL requires teachers to be even more professional.

- CAL will help teachers to develop new styles and skills.

4.3.3 Recommendations with regard to CAL

- CAL must not be restricted to programmed learning. Genuine computer applications for teaching and learning purposes should be encouraged.

- Materials should follow closely the theory of learning so as to avoid a situation in which pupils can answer questions but learn little. Group work by children should also be fostered.

- Computers should be integrated in teaching as a helpful method; different types of software should be used (simulation, calculation aids, data processing).

- Software should be flexible as regards its use, as well as transportable, so that it may be distributed easily. This will help the teachers to continue to be masters of their own teaching.

- Schools should favour interdisciplinarity when introducing CAL.

- In simulations the ideology behind the different models should be clearly expressed. Simulations should not be used to discontinue classroom practice.

- There should be more programmes in which the models are created and amended by the pupils rather than letting them just respond to altered parameters.

4.4 Pocket calculators

- European experience seems to indicate that pocket calculators should not be used before children have acquired the basic elements of calculation; nor before repeated exercises involving pocket calculators have been made.

- In no case would pocket calculators render genuine computer studies superfluous, as some people tend to believe.

4.5 Teacher education

4.5.1 General principles

There is general agreement over the following principles governing initial as well as in-service education and training of teachers (INSET):

- All teachers should learn about the technical methodological and educational aspects of computers to remove the fear of computers.

- These efforts should build upon educational (pedagogical) theory; teachers should learn to choose whether the computer is useful to them.

- Software and curriculum material for use with teachers must be promoted. Far too little is offered at present.

- Teachers with a degree in computer science should assist in teacher education. Ideally every large school should employ one or two such teachers (but in many countries they can hardly be found).

- Teachers should learn to appreciate how the computer can influence their role.

4.5.2 Initial teacher education

- In the same way as their pupils, all future teachers should be given an introduction to computers and their possible use in education. At present very little is done in this way in European colleges of education, except, perhaps, in the case of future technical or commercial school teachers.

- Future teachers should also acquire sufficient competence to be able to amend programmes in simple ways (e.g. to change data) but they need not be expected to write their own programmes. (They should, however, be able to explain their needs to programmers.)

- Future teachers wishing to teach computer science should have a more in-depth education in computer science in addition to education in their chosen subject matter.

4.5.3 In-service education and training of teachers (INSET)

Present situation and experience

- Some countries, but not all, are offering INSET programmes to familiarise teachers with computers.

- In some instances teachers were taught to prepare their own software and teaching material.

- If teachers are involved in curriculum development there are more easily prepared to accept computers in education.

- Experience in the UK has shown that good INSET schemes produce an insatiable demand. (Teachers were even made to build their own programmes and to evaluate and disseminate them.)

- INSET is much more important that initial teacher education because the numeric proportion between active teachers and teacher students is 90:10

and the present age pyramid makes it unlikely that many new teachers will be recruited within the next few years.

- INSET with regard to computers will require considerable financial outlay because of the enormous number of teachers to be trained.

Contents of INSET

- INSET should show that the computer may be a useful tool in all subjects and illustrate its advantages.

- INSET should offer the same general introduction which is recommended to all pupils.

INSET strategies

- INSET must never try to persuade teachers against their own will; neither must it be forced upon them from ministerial level.

- School-based INSET is helpful because it reaches more teachers than courses offered at some INSET centres.

- The best approach is to train selected teachers centrally, who would in their turn train at regional level and then these in their turn would train at local level. This model is popular, cheap and effective. It ensures local involvement and allows for local adaptations.

- INSET and curriculum development should go together.

- INSET might itself use the computer as a tool.

4.6 Research and evaluation

4.6.1 The situation as regards research

There is very little pure and academic research on computer-related instruction in Europe, but there is applied research in several countries.

Recommendations for research

- Research has to bear in mind the operational aspects and should not be too difficult nor beyond the financial resources of schools.

- Research should consider children's needs. Teachers should adapt to them and learn from them.

- Research should be developed in co-operation with teachers in the classroom.

- More research is needed on the didactical use of computers in different disciplines.

Evaluation of computer-related instruction and INSET

- Often evaluation cannot take place, because there are no clearly stated objectives.

- A programme is considered successful if observation of children in the classroom shows that things have changed since the programme was introduced.

- Evaluation needs feedback from teachers. It should, therefore, be an integrated part of any project and become the responsibility of the teacher.

- Findings should be recorded, reported and discussed with all involved.

- Case studies might well prove more important than formal evaluation.

5. CONCLUDING REMARKS

Whether the picture which has emerged from the Frascati Workshop will change in the near future is difficult to tell. Lack of funds may be an obstacle to progress. Implementation of some of the recommendations then made would require not only funds but a change of attitude, which may be difficult to bring about. Ministerial decrees alone will not change established patterns of behaviour or mentalities.

6. REFERENCES

- Complete collection of the Frascati papers (soon to be published by Swets Publishing Service, Heereweg 347b, NL-2160 AH LISSE (The Netherlands)).

- The Secretariat report on the Frascati Workshop (DECS/Rech (82) 42).

- Mr. W. BRODERICK's Final Report (DECS/Rech (82) 46).